The Pattern of Antibiotic Use in Trauma Patients and the Associated Risk of Nosocomial Pneumonia

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Introduction

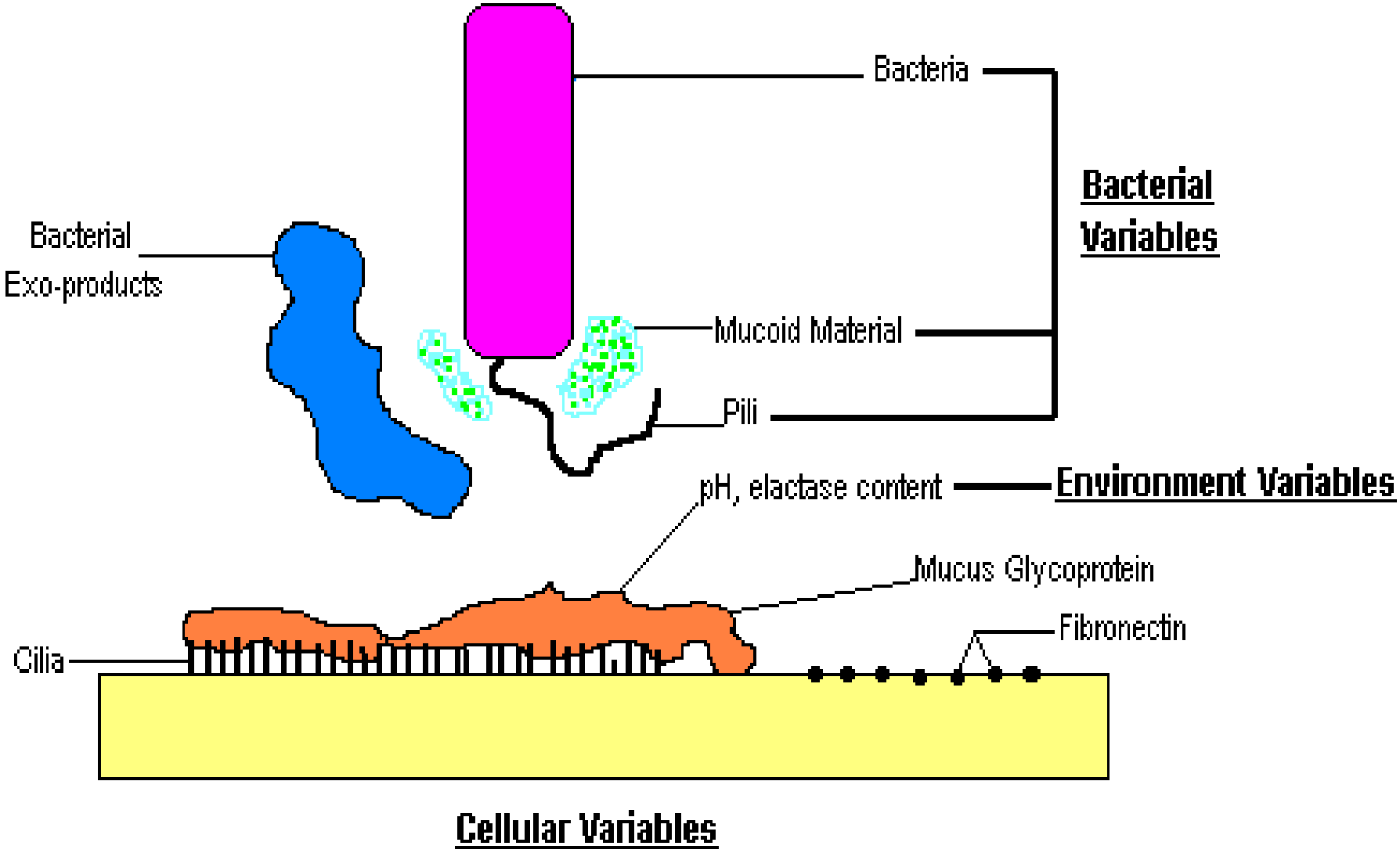
- Nosocomial pneumonia
  - 2nd most common nosocomial infection
  - Leading cause of death from nosocomial infections
  - Incidence

Statement and Significance of Problem

- Trauma patients
  - High risk
- Pre-treatment of antibiotics
  - Facilitate bacteria colonization
- Military relevance

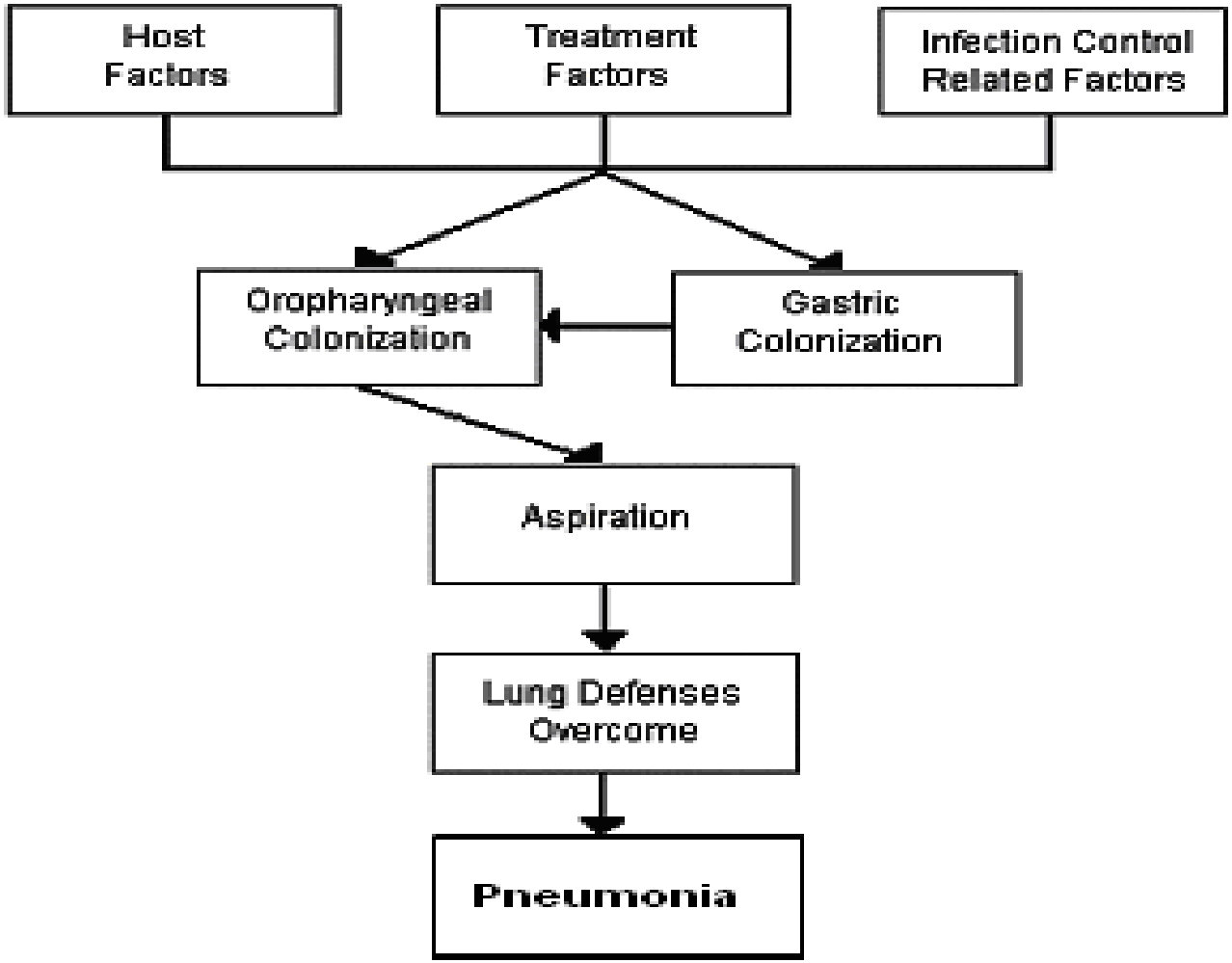
Theoretical Framework

(1 of 2)



Theoretical Framework

(2 of 2)



Review of Literature

- American Thoracic Society (1996)
  - Early-onset (EOP)
  - Late-onset (LOP)
- Bacterial colonization
  - Ewig et al. (1999)
  - Sirvent et al. (2000)
- Antibiotic pre-treatment

Purpose of Research

- Previous research:
  - Early-onset and Late-onset pneumonia studies limited
  - Class of antibiotic never studied
- To determine if a relationship exists between pre-treatment of antibiotics and the development of nosocomial pneumonia

Research Questions

1. What is the pattern of antibiotic treatment in trauma patients?
2. What categories of trauma patients receive prophylactic antibiotic treatment?
3. What is the relationship between antibiotic pretreatment and the development of early-onset and late-onset nosocomial pneumonia?

Methods (1 of 2)

Study design: Secondary analysis of a prospective, non-experimental, cohort study by Harris et al. (2001)

Instrument: Nosocomial pneumonia definition

- a new and persistent infiltrate on chest radiograph with the presence of one of the following:

Methods (2 of 2)

Nosocomial pneumonia definition (cont'd)

1) Positive blood culture obtained within 48 hours of analysis of tracheal aspirate, with the same organisms as seen the tracheal aspirate
2) Positive culture of pleural fluid, with observation of organisms identical with those observed in tracheal aspirate
3) All of the following:
   a) fever
   b) leukocytosis or leukopenia
   c) purulent sputum
   d) presence of organisms detected by gram stain of
      tracheal aspirates

Subjects

- Parent study: trauma patient population (n=581)
- Inclusion Criteria
  - At least 16 years of age
  - Serious injury to at least one body system
  - No evidence of pneumonia on admission
  - ICU stay greater than 72 hours
- Exclusion Criteria
  - Patients admitted only for a brief period of surveillance
  - Patients who died during initial hospitalization
- Current Study (n=576)

Data Collection (1 of 2)

- Parent Study: R. Adams Cowley Shock Trauma Center, University Maryland System
  - Enrolled within 24/48 hours of admission
  - Diagnosis was made of one of 4 infectious disease physicians
  - Followed daily by the Primary Investigator
  - End Points
    - Pneumonia
    - Discharged from ICU
    - 21 days

Data Collection (2 of 2)

- Current study
  - Surgical categories
    - Thoracic, Abdominal, Orthopedics, etc
  - Antibiotic categories
    - Cephalosporins, Beta-Lactams, etc
  - Duration of antibiotic administration
    - None
    - One dose
    - 24 hours
    - >24 hours

Limitations

- Treatments and procedures were not randomly assigned.
- The researchers had no control over what treatments and/or procedures the patients received
- Subglottic suctioning and monitoring of the endotracheal tube cuff pressure were not documented
- Cross-contamination and infection control issues were not addressed
- Investigators played no role in data collection.

Data analysis

- **Descriptive Statistics**
  - Frequency, central tendency, and standard deviation
  - Non-parametric data: Kruskal-Wallis Oneway ANOVA
  - Parametric data: Oneway ANOVA
- **Inferential Statistics**
  - Univariate and multivariate regression analysis

Demographics (n=576)

- Sample:
  - Male 72%
  - Age 40.8 years
- Pneumonia
  - Early-onset: 14.4% (n=83)
  - Late-onset: 12.3% (n=71)
- Age

Demographics (n=576)

- Injury Severity Scale and Acute Injury Scale
- Glasgow Coma Scale
- Invasive treatments
  - ICP monitoring
  - Nasogastric tube
- Intubation
  - Duration
  - Type of intubation
  - Integrity of cuff
- Duration of ICU stay
- Death

Surgery Demographics

- Surgery (n=404, 70%)
  - Orthopedic (n=255)
  - Early-onset vs. Late-onset
- Cephalosporins
  - Alone (n=251, 49.8%)
  - Combination (n=122, 24.2%)
- > 24 hour dosing (n=415, 82.3%)

Univariate Regression Analysis (1 of 3)

- **Early-onset vs. no pneumonia**
- Antibiotic class

  (*Chi-square 42.703, df= 7, p< 0.0009*)

  – Beta-lactums (odds ratio=5.22)

  – Cephalosporins (odds ratio=0.418)
- Antibiotic dose

  (*Chi-square 17.035, df=3, p<0.001*)

  – 24 hour dosing (odds ratio=2.140)

Univariate Regression Analysis (2 of 3)

- **Late-onset vs. no pneumonia**
- Antibiotic class

  (Chi-square 33.987, df= 7, p< 0.0009)

  - Beta-lactum and Cephalosporin combinations (odds ratio=7.816)
  - Combinations of 2 antibiotics (odds ratio=7.164)
  - Beta-lactum (odds ratio=6.141)
  - More than 2 antibiotics (odds ratio=3.821)
- Antibiotic dose

  (Chi-square 8.373, df =3, p<0.039)

  - Greater than 24 hour dosing (odds ratio=2.917)

Univariate Regression Analysis (3 of 3)

- **Late-onset vs. Early-onset**
- Antibiotic class

  (Chi-square 16.704, df= 7, p< 0.019)

  – More than 2 antibiotics (odds ratio=8.0)

  – Combination of 2 antibiotics (odds ratio=5.556)

  – Beta-lactum and Cephalosporins (odds ratio=4.286)

  – Cephalosporins (odds ratio=3.519)
- Antibiotic dose

  (Chi Square 20.385, df=3, p< 0.0009)

  – Greater than 24 hour dosing (odds ratio=4.976)

Multivariate Regression Analysis
(1 of 2)

- **Early-onset vs. no pneumonia**

  (Chi-square= 42.703, df=7, p<0.0009)

  – Antibiotic class (odds ratio=0.197)
    - Beta-lactums (odds ratio = 5.22)
    - Cephalosporins (odds ratio = 0.418)

- **Late-onset vs. Early-onset**

  (Chi-square=20.385, df=3, p<0.0009)

  – Antibiotic dose (odds ratio=0.855)
    - Greater than 24 hour dosing (odds ratio = 4.976)

Multivariate Regression Analysis
(2 of 2)

- **Late-onset vs. no pneumonia**

  (Chi-square= 33.987, df=7, p<0.0009)

  – Antibiotic class (odds ratio=0.168)
    - Beta-lactum and Cephalosporin combinations (odds ratio=7.816)
    - combinations of 2 antibiotics (odds ratio = 7.164)
    - Beta-lactum (odds ratio = 6.141)
    - more than 2 antibiotics (odds ratio = 3.821)

Implications

- Ewig (1999)
- Cephalosporins
  - Alone and combination
  - Prevented early-onset
  - Increased occurrence of late-onset
- What can we do?
  - Look at whole picture
  - Risk of resistant organisms

Conclusion

- Antibiotics in trauma patients
- Antibiotic class and dose
- Future studies

Questions?